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AUTOMATIC REGULATION OF THE AMPLIFICATION
IN TELE-CINE TRANSMITTING AMPLIFIERS
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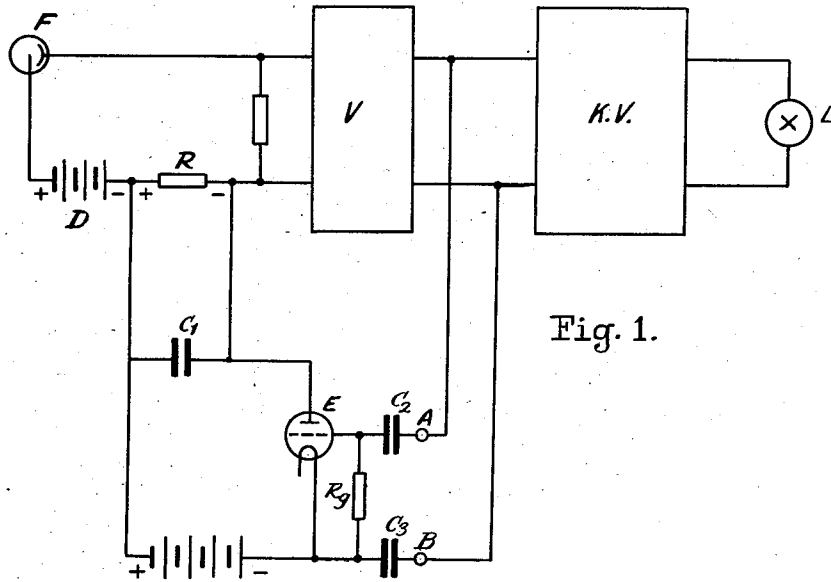


Fig. 1.

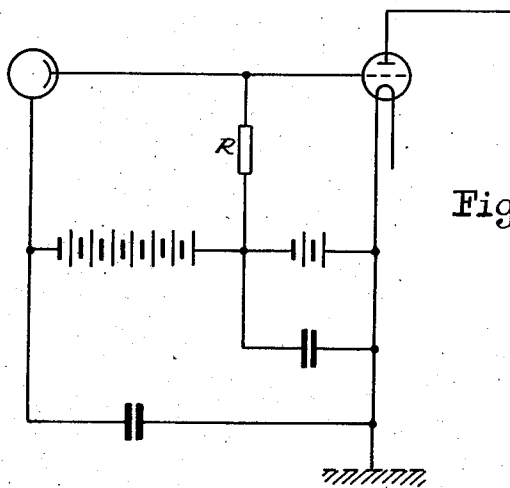


Fig. 2.

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UNITED STATES PATENT OFFICE

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AUTOMATIC REGULATION OF THE AMPLIFICATION IN TELE-CINE TRANSMITTING AMPLIFIERS

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7 Claims. (Cl. 178—6)

When using normal films for television transmissions (tele-cine) the fact that these films are sometimes very contrasty and sometimes rather flat is a disadvantage in that the transmitter amplifier is at times overloaded and at other times not provided with a signal strong enough for satisfactory operation. For true reproduction, the brightness of the modulated light source in the receiver must bear a definite relationship to the brightness of the film at any instant.

If a film very full of contrast is used and the transmission apparatus (photo cell, amplifier, etc.) are so adjusted that the light source in the receiver reproduces accurately the differences of light and shade in the original, it is then found that when a film without much contrast is transmitted, the received picture is very dull, in general, even duller than the original.

If, on the contrary, the apparatus is adjusted satisfactorily for a film without much contrast, any attempt to "televise" a film full of contrast will result in overloading the light source in the receiver.

Because of these differences, it has hitherto been necessary to have films especially copied for television transmission, which requirement made it difficult to combine various films into a satisfactory programme for transmission. It has also been the practice to endeavour to regulate the strength of the light in the receiver by hand during the transmission or to make other adjustments to the amplifier. This method is difficult and not always practicable, and in any case, requires considerable technical knowledge and great attention on the part of the operating staff.

As all the usual amplifiers and means of transmission at present in use are only capable of transmitting alternating current, it is apparent that the average brightness of the received picture does not depend on the density of the film but only on the differences of density; for example, a very lightly and a very darkly copied film, in which the differences of density are the same, will produce a similar television picture. The effect only depends on the density differences of the corresponding light amplitudes which are conducted to the light sensitive devices (photo cells). On the receiving side a certain alternating voltage is necessary for any given receiving light source, in order to produce a satisfactory result.

In accordance with the present invention means are provided whereby large variations of A. C. amplitude on the transmitting end are smoothed out in order that a more or less con-

stant A. C. amplitude is passed to the receiving light source. It is obvious that this compensation device must not be so constructed that it reacts on the amplitude alterations taking place during the transmission of a single film picture, but it must rather be made to work slowly. For example, it must only come into operation in the case where a contrasty and a dull film are to be transmitted consecutively.

In the drawing, Figure 1 is a schematic circuit diagram of our regulating device connected to a photo-electric cell and appropriate amplifying units.

Figure 2 is a circuit diagram illustrating means for automatically regulating the amplifier input in accord with the lighter or darker printing of the transmitting films.

The voltage variations produced by the photo cell F and amplified by the amplifier V are applied to the terminals A and B of the grid circuit of a thermionic valve E. The anode resistance of this valve E forms part of the photo-cell circuit.

The method of working is as follows:—

If the film is full of contrast, the voltage variations produced by the photo cell are large and therefore a large alternating current amplitude is applied to the terminals A and B of the valve E; as a result of this the anode current of the valve E and, therefore, the voltage drop across the resistance R become smaller. This results in a decrease of the photo cell voltage, which is composed of the voltage of the battery D and the voltage drop across the resistance R together. The photo cell, therefore, becomes less sensitive, and the light source L, which is connected to the output of the power amplifier KV, is supplied with a smaller alternating current amplitude.

Should a dull film be transmitted, there will be a scarcely perceptible alteration of the voltage drop across the resistance because of the smaller alternating current amplitude at the terminals A and B, and, therefore, the amplification will not be diminished. The device, therefore, works in such a way that a dull film can be easily transmitted even without the compensation device, but that in transmitting a film full of contrast, the alternating current amplitude supplied to the light source L is decreased, thus avoiding overloading.

In order to ensure that the compensation device does not react to rapid alternating current amplitude alterations, the resistance R is connected in parallel with a large condenser C₁, so that the time of charging and discharging is larger than the transmission period correspond-

ing to at least one film picture. The condensers C_2 , C_3 and the resistance R_g must be so proportioned that all frequencies contained in a picture are conducted in the correct amplitude relationship to the grid of the valve E. It is, of course, not necessary to restrict oneself to supplying to the amplifier a constant average alternating current amplitude, but one may equally well alter the degree of amplification by correspondingly modifying the given circuit, and directly or indirectly connecting the resistance lying in the anode circuit of the regulating valve in the grid or anode circuit of one of the valves of the amplifier.

As films of low contrast are often also printed quite dark, an absolutely automatic regulation of the amplification of the transmitter amplifier can be brought about in a simple manner by putting the resistance R in the photo cell circuit (see Figure 2), so that the grid of the first valve obtains its signal from the voltage drop across this resistance, thus automatically regulating the input according to the lighter or darker printing of the transmitting films.

The invention can be so arranged that by the aid of an auxiliary light source, or even the projection light itself, the film is illuminated and the transmitted light arranged to fall upon a resistance whose value depends on the illumination, for example, a second photo cell or a selenium cell.

The selenium cell can, for example, be used directly as a grid resistance of the first valve (see resistance R in Figure 2). The resistance of the selenium cell will then automatically become lower with lightly printed films and higher with darkly printed films, so that the amplification is automatically decreased in the first case and increased in the last case. The same effect can also be obtained by connecting the cell in the anode circuit. The brightness sensitive resistance (photo cell or selenium cell) can naturally be parallel with another ordinary resistance or even arranged to amplify the alternating current amplitude supplied to it. The invention can also be used on all usual connections of the photo cell and the first valve of the amplifier without further trouble.

Taken as a whole the idea of this invention lies in the fact that by using a quite simple method, a complete automatic regulation of the alternating current amplitude applied to the transmitting device, or the degree of amplification corresponding to the copying of the transmitting film results, in any case, in only a good television picture being sent out. A necessary condition is that the amplifier circuit is correctly proportioned and adjusted for a suitably chosen normal film.

Similar conditions to those in tele-cine apparatus also prevail with light ray scanning apparatus, and with daylight transmission. This invention is also applicable to these cases, with corresponding alteration. For example, in scanning transmitters and in a daylight transmitter, by following the first method, overloading of the amplifier can be avoided without difficulty. The second method, namely that using a selenium cell, can be so arranged that the selenium cell at the scanning transmitter is illuminated by the reflected light from the object being scanned, and the necessary electrical inertia produced by suitable circuit arrangements, for example, the connection of a condenser in parallel. This device can also be used with daylight transmitters.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In a television system for transmission of films of varying density, the combination of a photo cell and an amplifier at the transmitting end, and a light source depending upon its operation on an alternating voltage at the receiving end, means for automatically smoothing out excessive variations of alternating current amplitudes in the photo cell circuit when a film of great contrast is transmitted, in order to pass a substantially constant alternating current amplitude to the receiving light source, whereby an overloading of the latter is prevented, said means comprising a resistance in the circuit of the photo cell, a condenser shunted across the terminals of said resistance, and a thermionic valve having its grid circuit connected with the out-put of the amplifier and its anode circuit connected with the terminals of said resistance, whereby any excessive increase in the alternating current amplitude of the amplifier results in a lowering of the voltage drop across said resistance and in a decrease of the photo cell voltage.

2. In a television system for transmission of films of varying density, the combination of a photo cell at the transmitting end and an amplifier for the voltage variations produced by said photo cell, a light source at the receiving end operated by alternating voltage, including the arrangement of a compensating device adapted to supply said light source with substantially constant alternating current amplitudes to prevent an overloading of said light source, said compensating device comprising a thermionic valve having its grid circuit connected with the out-put circuit of the amplifier at the transmitting end, and having a resistance shunted by a condenser in its anode circuit, said resistance being arranged in the photo cell circuit to vary the voltage therein, to thereby decrease the sensitiveness of the photo cell when a film of great contrast is transmitted.

3. In a television system for transmission of films, pictures, scenes and the like by means of a photo-cell and an amplifier at the transmitting end and a light source depending upon its operation on an alternating voltage at the receiving end, means for selecting the low-frequency variations of alternating current amplitudes in the photo-cell circuit and means adapted for regulating automatically the alternating current voltage input of the amplifier to pass a substantially constant alternating current amplitude to the receiving light source, said means comprising in the circuit of the photo-cell a resistance shunted by a condenser and connected with its terminals to a circuit supplied with a voltage varying in accordance with the electrical impulses in the out-put circuit of said amplifier, whereby the voltage drop across said resistance is varied to vary the sensitiveness of the photo-cell.

4. In a television system for transmission of films, pictures, scenes and the like by means of a photo-cell and an amplifier at the transmitting end and a light source depending upon its operation on an alternating voltage at the receiving end, means for selecting the low-frequency variations of alternating current amplitudes in the photo-cell circuit and means adapted for regulating automatically the alternating current voltage input of the amplifier, to pass a substantially con-

stant alternating current amplitude to the receiving light source, said means comprising a resistance shunted by a condenser in the circuit of the photo-cell and a thermionic valve having its grid circuit connected with the out-put of the amplifier and its anode circuit connected with the terminals of said resistance, whereby any excessive increase in the alternating current amplitude of the amplifier as caused by excessive contrasts in the picture results in a lowering of the voltage drop across said resistance and in a decrease of the photo-cell voltage whereby an overloading of the light source at the receiving end is avoided.

5. In a television system, including a transmitter employing a photo-cell, a photo-cell circuit and means for amplifying the voltage variations produced by said photo-cell, a receiver provided with a source of light responsive to the alternating current amplitudes of said transmitter, and means for automatically controlling the alternating current voltage input of said amplifying means to pass a substantially constant alternating current amplitude to the source of light of the receiver to prevent an overloading of said source of light, said means comprising a thermionic valve, leads connecting the grid terminals of said valve with the out-put of said amplifying means, a condenser in each of said leads, and a resistance connecting said leads, and a resistance shunted by a condenser in the anode circuit of said valve, said last named resistance being arranged in said

photo-cell circuit to vary the voltage therein, the voltage and the sensitiveness of said photo-cell being decreased when due to excessive contrasts in the televised picture the alternating current amplitude applied to the grid circuit of said valve increases.

6. In a television system, means for developing picture signals and including a photocell, means for amplifying and transmitting said signals, means supplied from the amplifying means and operating to rectify the picture signals, and connecting means for applying the rectified picture signals to a control point in said system to vary the bias on said cell.

7. In television system for transmitting a motion picture film, means for developing picture signals, said means including a photocell and means for supporting and moving a motion picture film in cooperative relation with respect to said cell, and means for varying the negative voltage on said cell, said last-named means being responsive to conditions of variation in average light intensity to which said cell is subjected from a film during the respective picture-frame periods and being operable to effect variation in the negative voltage on said cell inversely proportionally to occurring variations in such conditions of light intensity.

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30